INTEGRAL ELASTOMERIC SUSPENSION ARTICLE AND MANUFACTURING PROCESS

CROSS-REFERENCE TO RELATED APPLICATIONS

Not Applicable.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not Applicable.

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

This invention relates to the field of seat suspensions and particularly to lightweight suspension systems using elastomeric materials and the methods of their manufacture.

2. DESCRIPTION OF RELATED ART

Conventional seat suspension systems used in the furniture and automotive industries can be broken down into several basic seat types.

One seat type uses formed wire, commonly called sinuous wire, to create the suspension article. Pieces of sinuous wire are formed into uniplaner shapes, usually repeating "S" curves, along their lengths. The wires transverse and are connected to a frame, and the wires may be connected together as they are suspended across the frame. This type of suspension system requires multiple part construction during assembly which increases its cost in use. Also, the suspension system is bulky and requires thick padding over the suspension article to prevent the user from feeling the wires. These systems are also quite heavy and require insulating material to prevent noise which can be generated by contact of the metal surfaces.

Another somewhat similar seat type is a manufactured wire grid, in which parallel wire members attached to a border element at their ends to form a support grid. The support grid is held to a frame by helical springs, wire forms or by the edge of the support grid itself. Again, this system can be time consuming to construct and install. Also, its metal construction can be noisy and inefficient and usually requires thick padding.

Another seat type uses elastomeric materials in the suspension article, including suspension articles made with individual elastomeric filaments, a sheet of elastomeric material, or a woven or knit elastomeric fabric. These designs are numerous but a woven elastomeric suspension article may be exemplified by U.S. Patent No. 4,869,554 to Abu-Isa, in which a material containing some type of elastic or elastomeric filament is used within the weave. The use of individual elastomeric filaments is exemplified by U.S. Patent No. 4,545,614, also to Abu-Isa, in which the suspension article has individual, parallel elastomeric filaments with ends that are secured to rods. The filaments are not connected to each other between the rods, and as compared to the manufactured wire grid, the rods and individual filaments perform similar functions as the border elements and the wire elements, respectively. Some elastomeric suspension articles may be formed from a solid sheet of elastomeric material as exemplified by U.S. Patent No. 3,375,861to Marlow, and others may start as a solid sheet of material that is sliced and pulled into a grid of twisted strips as exemplified by U.S. Patent No. 3,080,579 to Gordon.

These elastomeric suspension articles are usually pre-stretched and supported in a frame by known means, including clips, hangers, or ties. As evidenced by U.S. Patent No. 5,582,463 to Linder, it is also known to sew separate J-strip fasteners onto suspension articles for attachment to the frame. Similarly, as evidenced by U.S. Patent No. 2,791,807 to Morin, it is known to mold separate J-strip fasteners onto a perforated sheet of material. However, none

of these elastomeric suspension articles individually, or in combination, suggests a suspension article having an integrally formed elastomeric grid including an integral border element which may contain an integral J-strip fastener.

The disadvantages of these designs include increased manufacturing costs due to weaving and knitting operations, attaching individual filaments to rods, or otherwise forming a grid from a sheet of material, as well as that of connecting attachment elements to the suspension articles. Additionally, the cost of and structural weakness resulting from sewing a J-strip or securing a similar fastener to the material is a significant drawback. There is a also a disadvantage when providing an area for a hanger, resulting in an area where the article provides no suspension for the user of the seat. Finally, the lack of a cost effective and efficient method of stretching the units during installation limits their usefulness.

Various plastic meshes and nettings have also been tried to remedy the disadvantages of the above systems. These plastic arrangements exhibit many of the same disadvantages of their fabric counterparts. Specifically, their use of known methods for mounting the mesh or net to the frame results in structural weak spots as well as lack of effectiveness in uniformly supporting the user. Also, these units have exhibited a tendency to be difficult to stretch during installation.

BRIEF DISCLOSURE OF THE INVENTION

It is a purpose of the present invention to eliminate the above disadvantages by providing a suspension article comprising a frame, a substantially uniplaner non-woven grid, and fasteners. The grid is integrally formed with a pair of attachment strips, and the fasteners attach the grid to the frame through the attachment strips. In the preferred embodiment, the fasteners are a pair of J-strips integrally extruded with the attachment strips. In another aspect

of the invention, a process for producing a suspension article comprises the steps of forming a grid integrally with attachment strips, and stretching the grid between and attaching the grid to the frame through the attachment strips. In yet another aspect of the invention, the suspension article is attached to the frame through an adjustment means for changing the tautness of the grid, thereby allowing the suspension article to provide a range of support.

A second purpose of the present invention is to produce a lightweight suspension article comprised of an elastomeric grid which can be quickly and easily installed in a frame.

A third purpose of the invention is to produce a suspension article that provides effectively solid support for the user, thus eliminating the need for thick padding to prevent feeling the members of the suspension system.

A fourth purpose is to provide a suspension article with integral attachment strips and fasteners to eliminate as much as possible the weaknesses associated with subsequently attached fasteners.

A fifth purpose is to provide a suspension article which can be easily and efficiently stretched before or during installation.

A sixth purpose is to provide a suspension article with uniform or near uniform support over its entire surface and can provide a range of support depending on the tautness of the grid.

A seventh purpose is to provide a suspension article with reduced noise producing capability.

Other objects of the present invention will be apparent or pointed out herein.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of the preferred embodiment of the invention;

Figure 2 is a plan view of the grid for the preferred embodiment in its pre-stretched form;

Figure 3 is a perspective view of an alternate suspension article;

Figure 4 is a perspective view of an alternate suspension article;

Figure 5 is a perspective view of the preferred embodiment of the invention installed in an automobile seat.

DETAILED DESCRIPTION OF THE INVENTION

Turning to Figure 1, a suspension article **10** comprises a substantially uniplaner, non-woven grid **12** integrally formed with a pair of attachment strips **14, 16**. In the preferred embodiment, the grid **12** is comprised of an elastomeric material, and the attachment strips **14, 16** respectively include a pair of J-strip fasteners **18, 20**. The J-strip fasteners **18, 20** attach the grid **12** to a frame 22though the attachment strips **14, 16**. The grid **12** has closely-spaced primary members **24** that are connected by points of intersection **26** between the attachment strips **14, 16**. When the grid **12** is patterned as illustrated in Figure 1, the points of intersection **26** line up and form ribs **28** substantially perpendicular to the primary members **24** and the primary members **24** are substantially parallel to each other.

The close spacing of the primary members **24** is important to ensure that the support given by the suspension article **10** is as close to uniform as possible. In this way, the grid **12** may be used without padding, such as on outdoor furniture. Additionally uniform support ensures that the user will not feel the grid **12** even if thin padding (shown in Figure 4) is used. The close spacing also allows for efficient and effective stretching of the suspension article **10** in the direction of the primary members **24**. This can be accomplished by engaging hooks, tabs or other suitable elements of a stretching machine (not shown) between the primary members **24** at the attachment strips **14, 16**. By this secure engagement, the grid **12** can be stretched for mounting onto the frame **22**.

In the preferred embodiment, the grid **12** has a count of approximately five (5) primary members **24** per inch with equal spacing between them throughout the grid **12**. The count of the grid **12** may range from one (1) to twenty (20) depending on the application of the suspension article **10**. The grid **12** may also have variable spacing between the primary members **24** if desired so as to vary the amount of suspension at different regions of the suspension article **10**. Also, the spacing and count of the primary members **24** may depend on or vary with the width of the primary members **24**. In the preferred embodiment, the primary members **24** are approximately 0.06 inches thick with a known effective range of 0.02 inches to 0.10 inches in present applications. It should be understood, however, that the primary members **24** can be of any suitable size or shape and may vary in size and shape within a single grid **12** in order to provide, among other things, varying levels of support to the user.

The points of intersection **26** connect the primary members **24** and serve principally to maintain the spacing of the primary members **24** between the attachment strips **14, 16**, according to the pattern of the grid **12**. As presented above, the grid **12** is integrally formed with attachment strips **14, 16** which border the grid **12**. It will be appreciated that no part of the grid **12**, neither the primary members **24** nor the points of intersection **26**, is formed as an individual filament or as an attachment element separate from the grid **12**, thereby eliminating any need to alternatively (1) weave individual filaments together into a woven grid structure, or (2) use separate border elements for connecting individual filaments together in a grid structure, or (3) slice and pull an elastomeric sheet into a grid structure with twisted strips. Additionally, it will be appreciated that the attachment strips **14, 16** are not formed separately from the grid **12**, thereby eliminating any need to use separate attachment devices for connecting a grid structure to border elements.

It is possible to produce points of intersection **26** with a different thickness than the primary members **24** but in the preferred embodiment, the points of intersection **26** have the same thickness as the primary members **24**. Accordingly, for a grid **12** having ribs **28**, such ribs **28** preferably have the same thickness as the primary members **24**. Additionally, for a grid **12** having substantially parallel, non-intersecting primary members **24**, it is possible for the only points of intersection **26** to be located at each end of each of the primary members **24**, where the primary members **24** join the attachment strips **14, 16**, in which case there would not be any ribs **28** in the grid **12**. The grid **12** may also be formed in other patterns which have points of intersection **26** that do not form ribs **28**.

The J-strip fasteners **18, 20** are strips of material that are preferably extruded with the grid **12** in their hook shape. The J-strip fasteners **18, 20** can be secured over a frame edge or a protrusion to secure the grid **12** to the frame **22**. The J-strip fasteners **18, 20** may be continuous across the entire length of the grid **12**, as with the attachment strips **14, 16** or the J-strip fasteners **18, 20** may be discontinuous, located only at portions of the attachment strips **14, 16**, as desired.

Various elastomeric materials can be utilized to create the grid **12**. Suitable commercially available compounds include RIGHTFLEX sold by Ticona and HYTREL sold by DuPont. The preferred embodiment uses RIGHTFLEX. It should be noted, however, that the invention is not limited to using only these compounds. In general, elastomeric compounds with thermoplastic characteristics are most suitable for making the grid **12**. Accordingly, many known extrusion and injection molding methods can be used to make the grid **12** and attachment strips **14, 16** as disclosed herein, although the extrusion method is preferred. As illustrated in Figure 2, the grid **12** may be formed by initially producing a substantially uniplanar, pre-stretched grid **29** with integral attachment strips **14, 16**. The pre-stretched grid

29 is then stretched in the direction of the solid arrows to produce the grid 12 as described above and also illustrated in Figure 2.

Figure 3 shows a perspective view of the grid 12 with alternative attachment strips 30, 32, each of which respectively contains a wire 34, 36 embedded therein. The wires 34, 36 impart sufficient strength and rigidity to the attachment strips 30, 32 that the grid 12 can be secured to a frame 22 simply by engaging the wire with appropriate fasteners 38, 40, such as hooks, tabs, staples, wells, or other suitable elements of the frame 22. Just as the J-strip fasteners 18, 20 may be extruded discontinuously, when the wires 34, 36 are inserted into the attachment strips 30, 32, portions thereof may be extruded discontinuously, resulting in exposed portions of the wires 42 and providing discrete locations to attach fasteners 38, 40.

Figure 4 shows a perspective view of the grid 12 with flat, wide attachment strips 42, 44. The flat, wide attachment strips 42, 44 are appropriate for hooking, stapling, nailing, gluing, or other mechanical means of securing the grid 12 to the frame 22 with appropriate fasteners 38, 40. The thickness and width of the flat, wide attachment strips 42, 44 may vary as necessary for a given application. Additionally, a portion of the pre-stretched grid 29 may serve as the flat, wide attachment strip 42.

Referring to Figure 5, the suspension article 10 is shown in a vehicle seat 46. As illustrated, the suspension article 10 may be integrated into a lumbar support structure 48 in the backrest portion 50 of the seat 46 and may also be used in the bottom portion 52 of the seat 46. As used in the bottom portion 52, the suspension article 10 is formed and attached as discussed above. In particular, the grid 12 is integrally formed with attachment strips 14, 16, and the grid 12 is then stretched between and attached to the frame 22 through the attachment strips 14, 16. According to the preferred embodiment, the attachment strips 14, 16 are respectively extruded with a pair of J-strip fasteners 18, 20. It will also be appreciated

by those skilled in the art that the suspension article **10** may also be used in many support structures for different types furniture. For example, the present invention could be used in a bed, including a lightweight and inexpensive cot, futon or hammock.

As used in the lumbar support structure **48**, the grid **12** has at least one attachment strip **16** that is attached to the fame **22** through an actuated fastener **54** such that the attachment strip **16** can be moved relative to the frame **22**. The lumbar support structure **48** illustrated in Figure 5 operates by varying the tension across the grid **12**. As the actuated fastener **54** moves closer to the frame **22** and away from the other attachment strip **14**, the tension across the grid **12** increases. Similarly as the actuated fastener **54** moves further from the frame **22** and toward the other attachment strip **14**, the tension across the grid **12** decreases.

According to the preferred embodiment illustrated in Figure 5, the actuated fastener **54** has an actuator **56** and a bowden cable **58**. The bowden cable **58** has an unsheathed bowden cable section **60** connected between the frame **22** and the attachment strip **16** and a sheathed bowden cable section **62** connected between the frame **22** and the actuator **56**. The sheathed bowden cable section **62** may be directly attached to the frame **22** or may be attached through a mounting **64** on the frame **22**. Although the actuated fastener **54** is shown with an individual fastener **66**, separate from the attachment strip **16**, it will be appreciated that the attachment strip **16** could be integrally formed with a J-strip fastener **20** for attaching the unsheathed bowden cable section **58**. Similarly, the attachment strip **16** could be integrally formed with an attachment notch (not shown) for the unsheathed bowden cable section **58**, thereby producing an integral attachment element (not shown)

Of course, it will be appreciated that such a lumbar support structure **48** could alternatively move the pair attachment strips **14**, **16** rather than moving a single attachment

strip **16** and such alternative design would be within the scope of the present invention. Additionally, it is well-known that lumbar support can also be varied by moving a support structure towards the occupant, and it is anticipated that the suspension article **10** according to the present invention could function as this type of support structure in a lumbar support device (not shown). Finally, the lumbar support structure **48** could be fitted with a grid structure presently known in the art, such as an elastomeric fabric (not shown).

In view of the foregoing, it will be seen that the several advantages of the invention are achieved and attained. The embodiments were chosen and described in order to best explain the principles of the invention and its practical application to thereby enable others skilled in the art to best utilize the invention in various embodiments and with various modifications as are suited to the particular use contemplated.

As various modifications could be made in the constructions and methods herein described and illustrated without departing from the scope of the invention, it is intended that all matter contained in the foregoing description or shown in the accompanying drawings shall be interpreted as illustrative rather than limiting. For example, it will be appreciated that the grid pattern may be varied, as evident in U.S. Patent No. 3,252,181 to Hureau, without departing from the scope of the present invention. Thus, the breadth and scope of the present invention should not be limited by any of the above-described exemplary embodiments, but should be defined only in accordance with the following claims appended hereto and their equivalents.